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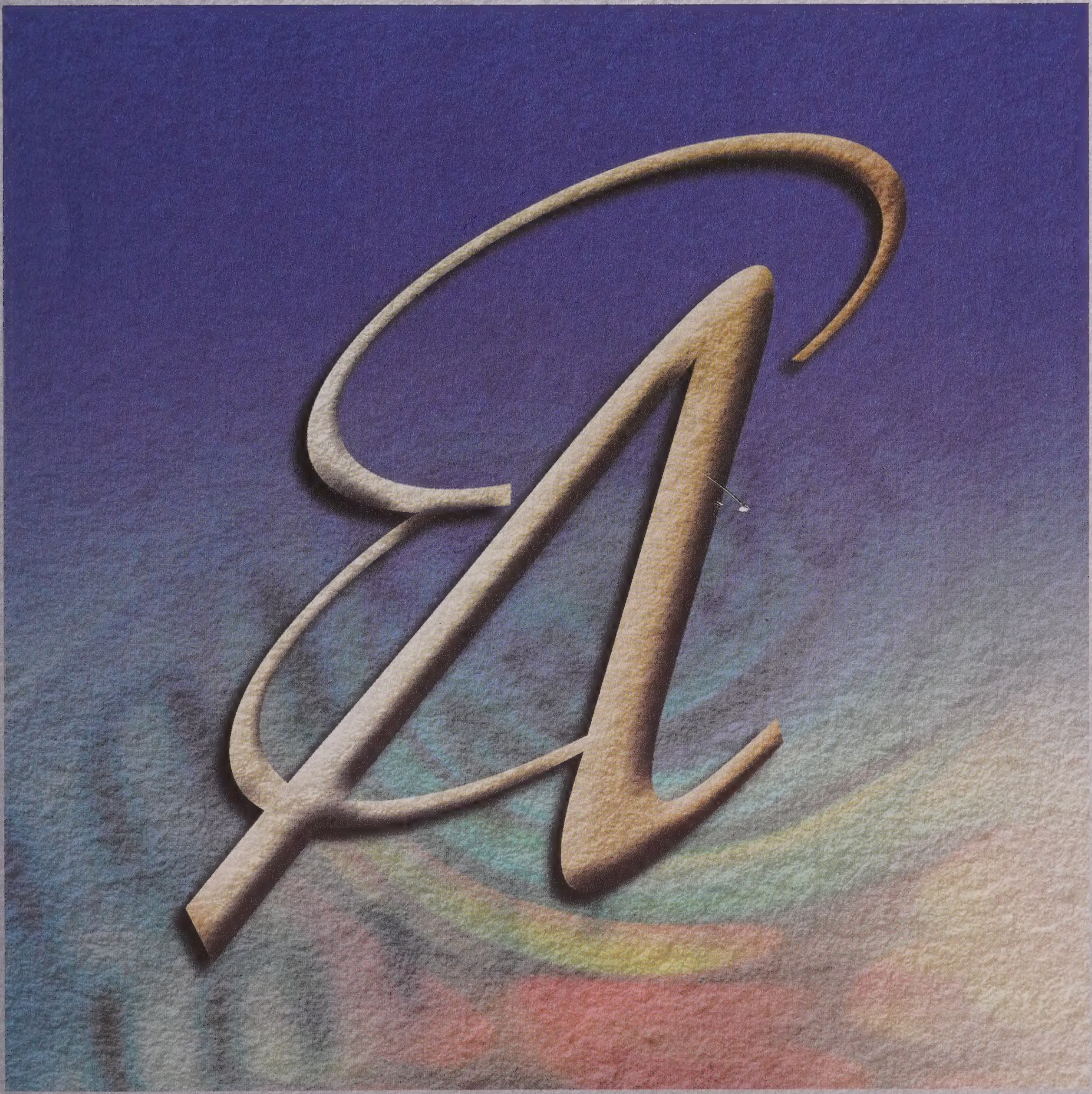
Overcoming Distance, Overcoming Borders: Comparing North American Regional Trade

by W. Mark Brown

No. 008



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11F0027 No. 008
ISSN: 1703-0404
ISBN: 0-662-32901-5

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April 2003

I would also like to thank the Faculties of Science and Graduate Studies and Research at McGill University for funding this research and David Johnson and Peter VanderWoude for their able research assistance. A previous version of this paper was presented to the North American Regional Science Meeting in Montreal (1999) and the American Association of Geographers Meeting in Pittsburgh (2000). I am grateful to the conference participants for their helpful comments. Of course, I am responsible for any remaining errors.

Aussi disponible en français

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Abstract

This paper utilizes a unique trade database that includes all provincial, state and cross-border trade in North America. The analysis shows that the border effect, although present, is not as strong as once thought and appears to be largely related to tariff and non-tariff based barriers to trade. There is also clear evidence that interprovincial trade is stronger than interstate trade, even in those sectors where the border effect is weak.

Keywords: border effect, Canada-U.S. trade, trade liberalisation, interprovincial trade, gravity model

Executive Summary

A growing number of studies have argued that national borders reduce trade by more than would have been expected on the basis of tariffs. In the context of Canada-U.S. trade, many of these studies, which use the relative strengths of interprovincial and province-state trade to measure the border effect, show the border acts as a surprisingly strong barrier to trade. Yet other analyses that use interstate trade, rather than interprovincial trade, as a benchmark indicate the border effect is much less. These contradictory findings imply how we measure the border effect matters and that there may be a significant difference between the strength of interprovincial and interstate trade.

Using data on U.S. interstate trade for 1993, as well as data on interprovincial and province-state trade for the same year, this paper offers an additional perspective on both the strength of the border's effect on trade and the relative magnitude of interprovincial and interstate trade. As such, the analysis presented herein provides a picture of all the regional trading relationships in North America, and most importantly, those factors that influence the strength of these relationships, including the border.

There are several specific questions that this paper attempts to answer regarding the border's influence on Canada-U.S. trade, the relative strength of interprovincial and interstate trade, and the potential effect of North American economic integration on interprovincial trade:

1) How strong is the border's influence on Canada-U.S. trade?

   - Previous estimates of the border effect that compared interprovincial trade to cross-border trade indicated that interprovincial trade was over ten fold stronger than cross-border trade, after controlling for the relative size of and distance between states and provinces. This study shows that when cross-border trade is compared to interstate trade the estimated border effect is substantially lower; interstate trade is on average two fold stronger than cross-border trade. Therefore, although the border remains a significant barrier to trade, its influence is much less than previous estimates.

   - The analysis shows that the border's effect on trade varies considerably across sectors and that its strength appears to be, in part, related to government imposed barriers to trade. For example, the border effect is strong for food products and textiles, sectors where there were still barriers to trade in 1993, and absent for transportation equipment, whose trade has been by and large tariff free since the 1960s. The implication of this finding is that in the long-run reductions in barriers to trade (e.g., tariffs and quotas) will likely lead to a North American economy that is highly integrated.

2) What is the strength of interprovincial trade relative to interstate trade?

   - The analysis shows that interprovincial trade is approximately six fold stronger than interstate trade. In other words, provinces are more tightly knit together through trade,

ceteris paribus, than U.S. states. On the surface, this result is surprising. It is not obvious why provinces would trade more with each other than U.S. states. However, in the context of historic barriers to trade with the U.S. that forced Canadians to trade with each other over long distances to satisfy their needs and to provide firms with markets large enough to produce goods more efficiently, the strength of interprovincial trade is logical. Americans, because of the size and density of the U.S. market, do not have to trade over such long distances to achieve the same gains from trade.

- ➢ The fact the interprovincial trade is much stronger than interstate trade explains why previous estimates of the border effect, which compared cross-border trade to interprovincial trade, indicated the border had a substantial effect on trade between provinces and states.

3) Is there a relationship between the strength of interprovincial trade and the degree of integration of the Canadian economy into the North American market?

- ➢ Although interprovincial trade is likely inflated because of restrictions on access to the U.S. market, there is no clear positive relationship between the magnitude of the border effect and the strength of interprovincial trade. This result is paradoxical because we would expect interprovincial trade volumes to begin to match those between U.S. states as provinces integrate into the U.S. market. Yet, in many sectors interprovincial trade remains strong even though the influence of the border on trade is small. It is unclear why this is so and, therefore, this result should be treated with some caution. It may be that the cost of trading over long distances is less in Canada than in the U.S. or it may be that Canadian firms, more than their U.S. counterparts, charge the same price for goods regardless of how distant the destination. This uniform pricing system makes the prices of good purchased from firms located thousands of kilometres away the same as those from firms producing in the local area, promoting long-distance flows.

Overall, this study provides a clearer picture of North American regional trade than previous work. The border remains a barrier to complete North American integration, but its effect is much less than previously thought and is at least partially related to government imposed barriers to trade that in the long-run may be eliminated. The analysis also shows that provinces trade more with each other than U.S. states, but it remains unclear whether further integration into the North American market will reduce interprovincial trade to the level of interstate trade.

1. Introduction

In recent years, a growing number of studies have demonstrated that national borders matter; that is, flows of goods, services and capital are considerably more mobile within countries than between them (McCallum, 1995; Helliwell, 1996 and 1998; Engles and Rogers, 1996; Wei,1996; and Anderson and Smith, 1999). Much of this work stems from McCallum's study, which found that—contrary to popular perceptions (Helliwell, 1996)—interprovincial trade was considerably stronger than trade between provinces and states.

In contrast to many of these studies, Brown and Anderson (2002) and Anderson and van Wincoop (2001) demonstrated that the border's measured influence on trade is much less when trade between provinces and states (cross-border trade) is compared to interstate trade. This paper extends Brown and Anderson's analysis, and connects it to the previous work by McCallum, Helliwell and others, by merging into one data set interstate, interprovincial and cross-border trade. In so doing, it is possible to directly measure the difference between interprovincial, interstate trade and cross-border trade.

Anderson and van Wincoop (2001), whose work was conducted concurrently with this study, also combine into one data set interstate, interprovincial and cross-border trade. This paper differs from Anderson and van Wincoop's in several respects, the most important being that interregional flows are disaggregated by industrial sector. Using disaggregate flows improves our insight into the nature of North American economic integration in two ways. First, it possible to measure the degree to which the influence of the border on trade varies across the products of various industrial sectors. In so doing, it can be ascertained whether there is a relationship between formal barriers to trade and the border effect. Second, by using disaggregate flows, it is possible to test whether there is a relationship between the degree of integration into the North American market and the strength of interprovincial trade. Intuitively, as markets become more accessible across the border the expectation is that Canadian producers will pursue more proximate U.S. markets rather than often distant and small regional market in Canada. Interprovincial trade should therefore fall as a result North American integration.

The analysis shows that interprovincial trade is some six times stronger than interstate trade. That is, after controlling for the size of state and provincial economies and the distance between them, interprovincial trade is much stronger than interstate trade. The implication of this finding is that previous studies that relied on interprovincial trade as the benchmark against which cross-border trade was compared may have substantially overestimated the trade dampening effect of the border. This is confirmed when interstate trade is compared to cross-border trade. On aggregate, cross-border trade is approximately half the level of interstate trade, suggesting a strong but not overwhelming influence of the border on trade. This compares to previous estimates that suggested interprovincial trade was some twelve fold stronger than cross-border trade (Helliwell, 1998), evidence of a much stronger border effect. Anderson and van Wincoop (2001), using statistical methods and data that vary somewhat from those used here, obtain qualitatively similar results; interprovincial trade is substantially stronger than interstate trade and the dampening effect of the border is much less when cross-border trade is compared to interstate trade.

There are two other major findings. The first is that there appears to be strong relationship between the border effect and formal barriers to trade. In those sectors where tariff and non-tariff barriers are commonly thought to be low, we observe a relatively small border effect and for those sectors with high barriers to trade the border effect is high. Therefore, government policies that directly affect trade still have a strong influence on the strength of cross-border trade.

The second is that there is no apparent relationship between the level of cross-border trade and the strength of interprovincial trade. In those sectors where the border has little influence on the volume of trade—the level of cross-border trade, *ceteris paribus*, is very similar in magnitude to interstate trade—interprovincial trade remains much stronger than interstate trade. This is a surprising result because it contradicts the expectation that as Canada integrates into the North American market producers and consumers should turn to more proximate U.S. markets and suppliers rather continuing to trade over long distances within Canada. It is speculated below that the robustness of interprovincial ties may result from potentially less competitive market conditions in Canada that allow firms to change a single delivered price for goods across the country rather than allowing prices to vary with distance. It is also suggested that persistence of interprovincial trade ties may also result from interpersonal networks built up prior to the lowering of trade barriers under the Canada-U.S. Free Trade Agreement and the North American Free Trade Agreement.

The rest of the paper is organized as follows. Initially, a concise review of the literature, which focuses on previous work on the border effect and its implications, is provided (Section 2). Subsequently, the relationship between borders, spatial structure and trade is outlined as well as the hypotheses that will be tested in the analysis (Section 3). The next section discusses the characteristics of the model (Section 4) and this is followed by a brief review of the data used in the analysis (Section 5). The results of the trade analysis are then reviewed (Section 6) and the final section of the paper provides a brief conclusion (Section 7).

2. *Evidence of the Border Effect and its Implications*

As explained above, there has been a consistent finding in the literature that borders continue to have a strong influence on international trade. McCallum's (1995) analysis, which used data from 1988, demonstrated that internal Canadian trade was twenty fold stronger than cross-border trade, after controlling for the economic weights and distance between the trading regions. McCallum argued his results provided evidence of a strong border effect. More recent analyses indicate the border effect declined to around twelve fold by the early 1990s and has stabilized around that value in more recent years (Helliwell, 1998). In Brown and Anderson (2002), we found that internal U.S. trade was approximately twice as strong as cross-border trade. This result implies that the influence of the border on trade, although still important, is substantially less when interstate trade, rather than interprovincial trade, is used as a benchmark.

Work has also been undertaken to determine the influence of borders on other economies. Wei (1996) found that domestic imports (within nation trade) was two and a half fold larger than foreign imports in the OECD. Using data on OECD and several developing countries, Helliwell (1998) has also demonstrated that internal national trade is stronger than cross-border trade. His analysis indicated that even in the European Union, which arguably has progressed the furthest in eliminating barriers to trade, the border effect remains significant, ranging from approximately four to six fold depending on whether the trading nations shared a common language. Although the presence of the border effect in Helliwell's and Wei's results is not in doubt, the magnitude of the border effect outside of North America remains unclear because internal trade distances are unknown, and therefore, have to be assumed.

In a broad sense, the results of McCallum, Helliwell and others imply the potential for economic integration on a regional or global scale is more limited than once thought. Helliwell (1998, p. 123) notes that

> " . . .as long as national institutions, populations, trust, and tastes differ as much as they do, the industrial organization and other institutional literatures would predict that transactions costs will remain much lower within than among national economies, even in the absence of any border taxes or regulations affecting the movement of goods and services."

In other words, even though a country may possess a comparative advantage across a range of industries, the higher transaction costs associated with trading across national borders may nullify this advantage.

It remains to be seen whether in the context of Canada-U.S. trade we have reached the point where the benefits of greater integration are outweighed by higher transaction costs across the border. As noted above, Helliwell (1998) has found the border effect has stabilized since 1993. Baldwin, Beckstead and Caves (2001) provide indirect evidence to this effect. They find that commodity specialization at the plant level was greatest for plants that moved strongly into export markets and that there was increasing commodity specialization at the plant level between 1989 and 1993, which, in turn, slowed between 1993 and 1997. The data used in the analysis here are for 1993, and therefore, the estimated border effect presented below may be close to its long-run level.

3. *Spatial Structure, Borders and Trade*

In Brown and Anderson (2002), we hypothesized that the substantially higher border effect that emerged when interprovincial trade was used as a benchmark resulted from the interaction of two factors: first, the different geographic patterns of production in Canada and the United States—their spatial structure—and second, the trade dampening effect of the border itself. To understand better why this is the case, it is useful to engage with Anderson and van Wincoop's (2001) theoretical findings regarding the impact of borders on interregional trade.

Anderson and van Wincoop show that the level of trade between two trading regions depends not only on the level of resistance to trade between them (e.g., transportation costs and tariff barriers), but also on the degree of trade resistance between these two regions and all their trading partners – multilateral trade resistance. In other words, two regions facing a high degree of resistance with all other regions will tend to trade more with each other, *ceteris paribus*, than two regions with a lower degree of resistance with other regions. This is because of two factors. First, from the perspective of an importing region, higher barriers to trade between it and other trading regions will make the price of goods from a region whose trade is relatively unaffected by those barriers appear less expensive, increasing demand for this one exporting regions products relative to the others. Second, from the perspective of the exporting region, high barriers to its trade with other regions will result in lower demand for its goods, lowering its equilibrium supply price, and therefore, increasing bilateral trade with the region relatively unaffected by these barriers. The opposite is true for a pair of regions whose multilateral resistance to trade is low. In their case, there are many other sources of goods to choose from or markets to sell to at prices that are competitive, resulting in trade flows that are lower between these two regions compared to those facing higher levels of multilateral resistance.

It is important to note that the multilateral resistance to trade depends not only on tariff barriers but other costs associated with moving goods over space such as transportation costs. The implication is that geographically isolated regions will trade more with each other than those that are more centrally located. Therefore, those regions isolated by distance from markets *and/or* by artificial barriers to trade will tend to trade more with each other than those that are more accessible.

What then do these theoretical findings imply for North American regional trade? Canadian regions experience a potentially higher multilateral resistance to trade because there are substantial transaction costs associated with trading across the border and because of the relative remoteness Canada's regions, its spatial structure. Effectively, the Canadian economy functions over a thin, dispersed market that stretches east-west along the U.S. border; hemmed in by largely uninhabited land to the north and the U.S. border to the south. In contrast, the U.S. economy has no comparable economic or geographic limitations. Its market is larger, denser and more evenly spread over space. Therefore, because of barriers to trade associated with the border and Canada's spatial structure, Canadian regions encounter a higher level of multilateral resistance than their U.S. counter parts. Consequently, any measure of the border effect that uses interprovincial trade as a benchmark may be substantially biased upwards. *Hypothesis 1* follows directly from this logic:

Hypothesis 1: Interprovincial trade should be stronger than interstate trade, holding all other factors constant, if the border remains a significant barrier to trade.

Hypothesis 1 also implies that in a world where borders no longer matter, internal Canadian trade should fall as firms turn to more proximate suppliers across the border. *Hypothesis 2* is directly related to this point:

Hypothesis 2: There is an expected positive relationship between the strength of the border effect and the intensity of interprovincial trade relative to interstate trade across sectors.

Comparing the level of interstate to interprovincial trade will test Hypothesis 1 in the analysis. Hypothesis 2 will be tested in the analysis be observing whether there is positive relationship between the border effect and the relative level of interprovincial trade across sectors.

Overall, this discussion of the relationship between borders, spatial structure, and regional trade implies that interprovincial flows are likely to be inflated relative to interstate trade. The implication, therefore, is that interstate trade may be a better benchmark. This is because it is unlikely restricted access to the Canadian market would significantly affect the pattern of interstate trade. The Canadian market is simply too small to have much of an effect on the level of multilateral resistance experienced by U.S. regions. Anderson and van Wincoop (2001) findings support this contention. Consequently, throughout the analysis the level of interstate trade relative to cross-border trade will be used to measure the border effect.

4. Trade Model

The gravity model has been used in all of the analyses described above because it allows the measurement of the border effect while controlling for distance and output, as well as other factors. Although the gravity model has proven to be statistically successful, it says little about the underlying causes of trade because the model can be derived from increasing returns (Krugman, 1979; Helpman and Krugman, 1985) and factor-proportions (Deardorff, 1995) explanations of trade. Therefore, although the gravity model is an effective tool for testing hypotheses regarding those factors that affect the volume of trade (e.g., the border), it is not an effective test of two of the primary explanations of why nations trade.

In this paper a constrained version of the gravity model[1] is used to estimate the influence of the border on trade. The model takes the following functional form

[1] See Haynes and Fotheringham (1984) or Sen and Smith (1995) for a comprehensive discussion of the gravity model in its various forms.

$$T_{i_{AB}} = \sum_{j=1}^{m} a_{ij} X_{j_B} \frac{\left(p_{i_A}^{v} \tau_{AB}\right)^{\varepsilon} X_{i_A}}{\sum_{A=1}^{r} \left(p_{i_A}^{v} \tau_{AB}\right)^{\varepsilon} X_{i_A}}, \tag{1}$$

where $T_{i_{AB}}$ represents the value of exports from regions A to B in sector i goods, a_{ij} is a technical (input-output) coefficient, X_{j_B} is the output of sector j in region B, $p_{i_A}^{v}$ is the f.o.b.[2] price of a variety of good i produced in A, τ_{AB} is the per unit transportation costs between the two regions, X_{i_A} is the output of sector i in A and ε is the elasticity of demand for sector i goods. It is assumed that each region specializes in the production of different varieties of goods produced by industry i. The complete derivation of this model from micro-foundations can be found in Brown and Anderson (2002).

The trade model expressed by (1) implies that exports of good i from region A to B is positively associated with the total demand for good i in B, $\sum_{j=1}^{m} a_{ij} X_{j_B}$. Trade between the two regions also depends on the relative attractiveness of A as a source of good i, which in turn depends on the delivered price of varieties of good i, $p_{i_A}^{v} \tau_{AB}$, and the level of output of i, X_{i_A}, in A relative to the delivered price of goods available from all other regions and the size of their industries. Therefore, the model not only takes into account the level of supply and demand in A and B, but also the size, location and other characteristics of all other potential suppliers of goods to region B. In the context of the *Hypothesis 1*, the model explicitly recognizes the fact that if A and B are located in Canada and there are high transaction costs across the border, there will be a strong incentive to purchase goods in Canada. Therefore, the model, at least in part, accounts for the influence of multilateral resistance on trade flows.

There are two additional reasons for choosing this type of gravity model. First, it provides an interpretation of the micro-economic underpinnings of the demand for of interregional trade. The model is based on the premise that any consumer/firm is faced with a choice of where to purchase their consumer goods/inputs. This choice is influenced by the delivered (c.i.f.[3]) price of the goods, the elasticity of demand and the level of supply found in each region. In Brown and Anderson (2002), we derive (1) from Krugman's (1980) "love of variety" utility function, which we also treat as a production function for downstream producers.[4] Therefore, the elasticity of demand depends on the demand for variety on the part of consumers and firms. If the demand for variety is high (the elasticity of demand is low) variations in c.i.f. prices will have little influence on demand; the exporting region's relative level of output is the primary determinant of the volume of trade. On the other hand, if the demand for variety is low, c.i.f. prices will contribute the most to the model's explanation. Therefore, the estimated distance parameter of the gravity

[2] The acronym f.o.b. stands for free on board.

[3] The acronym c.i.f. refers to cost, insurance and freight.

[4] The "love of variety" approach implies that the model is based on the assumption that trade is driven by increasing returns rather than factor proportions, which is based on the assumption of homogeneous goods. Of course, a factor proportions explanation cannot be excluded, and therefore, the model only provides a partial micro-economic explanation of interregional trade.

model reflects, at least in part, the combined influence of the demand for variety on the part of consumers/firms and variations in c.i.f. prices across space.

The second reason for choosing this particular form of the gravity model is that the data used in the estimation are disaggregated by 2-digit USSIC industries. Disaggregated trade flows by industrial sector presents a problem for conventional gravity formulations because they use regional (state/provincial) GDP as a measure of supply and demand. That is, because industries tend to be over represented in some regions and under represented in others, the supply of goods and the demand for intermediate goods[5] will not necessarily be perfectly correlated with state or provincial GDP levels. In their place, a measure regional demand (both intermediate and final) specified in the model, $\sum_{j=1}^{m} a_{ij} X_{j_B}$, could be used. However, as will become apparent below, using this specification it is not necessary to measure regional demand in order to estimate the model. Nevertheless, regional demand is used, but it only enters indirectly through a market potential measure defined in the next section.

There are several reasons to disaggregate flows by industry, but the most important is that it provides a means to test whether the strength of interprovincial trade relative to interstate trade is positively associated with the border effect (*Hypothesis 2*). That is, in the absence of time series data, disaggregated flows by industry are required in order to observe variation in the estimated border effect and the relative strength of interprovincial trade.

A more generalized version of the model is required for estimation since data on prices and transportation costs are largely unavailable and there are other factors, such as the border, that have a systematic affect on trade flows. In its generalized form, the model is specified as:

$$T_{i_{AB}} = \sum_{j=1}^{m} a_{ij} X_{j_B} \frac{\prod_{k=1}^{l} z_{k_{i_{AB}}}^{\eta_k} X_{i_A}^{\varphi}}{\sum_{A=1}^{r} \prod_{k=1}^{l} z_{k_{i_{AB}}}^{\eta_k} X_{i_A}^{\varphi}}, \tag{2}$$

where the z_{ki}s are a set of variables (continuous and nominal) that influence the choice of from what region goods are imported.

Equation (2) can be estimated by using the following specification:

$$T_{i_{AB}} = a \prod_{B=1}^{r-1} \exp(\delta_B) \prod_{k=1}^{l} z_{k_{i_{AB}}}^{\eta_k} X_{i_A}^{\varphi} \mu_{i_{AB}}, \tag{3}$$

where a is a constant, δ_B is a dummy variable indexed by each destination B[6] and $\mu_{i_{AB}}$ is a disturbance term. The dummy variables constrain the model to ensure that predicted total flows into (and within) each region equal the total observed flow. This constraint can be approximated

[5]Intermediate goods account for over 40% of Canada-U.S. trade (Brown and Anderson, 1999) and presumably a similar proportion of internal Canadian and U.S. trade. Therefore, if production is differentiated over space so will demand for a significant proportion of the goods traded in North America.
[6]One destination must be dropped in order to avoid perfect multicollinearity.

by using the logged form of equation (3) and estimating the model using ordinary least squares (OLS). Maximum likelihood estimation (MLE) constrains the model perfectly, and for this and other reasons is often viewed as superior (see Sen and Smith, 1995). Nevertheless, OLS was chosen for its well known statistical properties and because previous work indicated that MLE resulted in estimates of the border effect that are not qualitatively different than those obtained using OLS (Brown and Anderson, 2002).

5. Data

In this section, the variables that are included in the estimated model and the reasoning behind their inclusion are discussed. The analysis requires measures of regional trade and a set of variables that are used to statistically explain the volume of regional trade. These variables will be described in order below. For the interested reader, Appendix A discusses the data and their sources in greater detail.

The dependant variable used in the analysis is intra/interregional trade in manufactured goods, which are disaggregated by 2-digit sector (USSIC) for the year 1993. The data set includes state, provincial and cross-border flows. Effectively, the model covers almost all major regional trade flows in manufactured goods in North America. Manufactured goods accounted for just over 80% of cross-border trade in 1993 (Brown and Anderson, 2002), and therefore, this analysis can be seen as largely representational of the overall Canada-U.S. merchandise trading relationship.

Intra and interstate trade flows are derived from the U.S. Bureau of Transportation Statistics' Commodity Flow Survey (CFS). Statistics Canada's Annual Survey of Manufacturers (ASM) reports the provincial distribution of shipments of manufacturers and these flows are used to estimate intra and interprovincial trade. For several manufacturing sectors, the ASM overestimates provincial trade due to the fact that some goods that are reported as domestic shipments are eventually exported. Although the overestimation of domestic trade is relatively minor, the data are adjusted to account for this potential bias. Appendix B describes the methodology to modify the data. Finally, cross-border trade flows are drawn from Statistics Canada's Trade, Information, Enquiry and Retrieval System (TIERS) database, which reports trade flows between states and provinces.

Turning the discussion to the independent variables used in the analysis, Table 1 summarizes the variable names, their definitions and expected signs. As implied by equation (3), the model includes the level of manufacturing output generated by each origin (OUTPUT), which is expected to have a positive influence on the volume of trade. Variations in c.i.f. prices are measured using the distance between each origin and destination (DIST), labour productivity (PROD), and wages (WAGE). Distance is used as a proxy for the influence of transportation costs on prices. It is assumed that those places with higher labour productivity and lower wages, will, *ceteris paribus*, be able to supply goods at a lower f.o.b. price. Therefore, even if a region is relatively remote compared to other competing regions, it still may be competitive in a market if its firms' level of labour productivity for and/or wage rates result in lower costs and prices.

The border effect is measured using a dummy variable for cross-border trade (CANUS). To measure the hypothesized higher internal Canadian trade (*Hypothesis 1*), a dummy variable is included for trade between and within Canadian provinces[7] (PROV). Dummy variables for within province (INPR) and within state (INST) trade were also included. There are two reasons for their inclusion. First, within each two-digit industry there may be a subset of goods that are produced primarily for local markets.[8] If this were true, these goods would tend to inflate intraprovince/state trade. Second, the U.S. data includes flows from non-manufacturing establishments, which may enlarge intrastate trade. This issue is discussed in more detail below.

Since local markets are likely to spill over state, provincial and international borders, dummy variables were added for contiguous provinces (CNTGPR), contiguous states (CNTGST), and states and provinces that share a common border (BORDER). The BORDER variable may also capture the consolidation of imports in bordering states and provinces (e.g., in customs warehouses), which are eventually distributed to other regions.

Trade between non-contiguous states is the benchmark against which all other flows are compared because of the structure of the dummy variables described above. Therefore, CANUS compares cross-border flows between states and provinces, after controlling for the consolidation of shipments in bordering regions (BORDER), to interstate trade. PROV can be interpreted as the strength of interprovincial trade relative to the interstate benchmark, after controlling for within province and contiguous provincial trade.

Internal U.S. trade flows include shipments from manufacturing plants, secondary establishments (e.g., firm-owned warehouses) and wholesalers[9], which implies some goods are double-counted. For example, a shipment of the same goods from a manufacturer to a wholesaler and then to a retailer within the same state, or to another state, would result in those goods being counted twice. This is confirmed by the fact that measured levels of trade in manufactured goods generated by states are often higher than their output. This problem is partially accounted for by the OVREST variable, which is calculated by taking the total flow generated by each state and dividing it by the total shipments of that sector in the state. OVREST only accounts for variability across states, and therefore, it cannot completely account for the double counting problem. To the extent that shipments to or by secondary establishments and wholesalers are more likely to occur over shorter distances, the INST and CNTGST variables may also account for their presence in the survey. This is the reasoning behind using separate variables for intra province/intra state trade and contiguous provinces/contiguous state trade.

As noted above, the remoteness of Canadian provinces, relative to their U.S. counterparts, may explain the strength of interprovincial trade relative to cross-border trade. That is, the volume of trade between any origin-destination pair not only depends on their location and characteristics

[7]Note that New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland were aggregated into one region for the analysis. Therefore, there is effectively only seven 'provinces' used in the analysis. These provinces were aggregated into one region because imports from the United States are reported by 'province of clearance'. Since New Brunswick, is the only province in this region with a land border with the United States its imports would tend to be inflated. The converse would be true of the other provinces.
[8]For example, some firms may specialize in producing inputs for local industries (e.g., packaging) or for the local consumer market (e.g., bakery products).
[9] In addition to wholesalers, selected retailers were also included in the survey.

but also on the location and characteristics of other regions. As specified, the gravity model outlined above does take into account the location of a particular market relative to the location of other potential suppliers and the resistance to trade between them. As such, it compensates for the fact that a firm located in a remote region will tend to purchase more from an origin, *ceteris paribus*, than a firm located more centrally. However, the model does not take into account the fact that producers located in a more remote region will tend to trade more over a given distance (e.g., in order to take advantage of scale of economies), *ceteris paribus*, than those located more centrally. This can bias downward the estimated border effect if Canadian regions are, on average, more remote than their U.S. counterparts. This effect can be controlled for partially by introducing a market potential variable (MP) that measures the location of each origin relative to potential sources of demand discounted by distance:

$$MP_{i_A} = \sum_{B=1}^{r} Y_{i_B} d_{AB}^{\hat{\beta}}, \qquad (4)$$

where Y_{i_B} is the demand in region B for sector i goods (see Appendix A for details on how demand was estimated), d_{AB} is the distance between A and B and $\hat{\beta}$ is an estimated distance parameter, with MP excluded initially from the model. Since $\hat{\beta}$ is likely to change with the market potential measure included in the estimation, an iterative estimation procedure is employed to account for this effect. That is, the new estimated $\hat{\beta}$ is used to re-calculate the MP measure and the model is estimated again with the newly calculated MP. This procedure is repeated until the change in $\hat{\beta}$ meets a convergence criterion ($\Delta\hat{\beta} < 0.0001$).

It is important to note that because the MP measure does not account for the border effect directly it may be overestimating the market potential for Canadian regions, leading to an underestimation of the border effect and an overestimation of the relative level of interprovincial trade.

Table 1. Variables Used in the Analysis

Variable Name	Variable Definition	Expected Sign
OUTPUT	output of sector i in region A	+
DIST	road distance between the largest urban area in each region and for internal state/province trade the radius of a circle equal to the area of the state/province	-
PROD	value added per employee	+
WAGE	pay per employee	-
CANUS	trade between provinces and states	-
PROV	trade within and between provinces	+
BORDER	the Canadian and U.S. trading regions share a common border	+
INST	internal state trade	+
INPR	internal province trade	+
CNTGST	trading states share a common border	+
CNTGPR	trading provinces share a common border	+
OVREST	total trade from an origin measured by the CFS (Bureau of the Census,1997) divided by total shipments measured by the U.S. survey of manufacturers (Bureau of the Census, 1996)	+
MP	market potential	-

6. Results

This section of the paper presents the results of the analysis. Initially, the model's general findings are discussed, outside of those that compare cross-border and interprovincial trade to interstate trade. The discussion then turns to the model's findings as they relate to relative levels of interregional trade in North America in the context of the two hypotheses outlined above. This section is concluded with an informal test of the ability of the model to account for spatial structure and some speculation as to why *Hypothesis 2* is not confirmed.

General Findings

The parameter estimates of the full model are presented in Table 2. In all cases, the parameters for OUTPUT and DIST take their expected positive and negative signs, respectively. With the exception of Leather Products, they are also highly significant. The parameter estimates for WAGE and PROD are less consistent. Although in several instances the WAGE variable is negative and significant (e.g., Apparel), it also takes on a positive and significant value for several sectors (e.g., Lumber & Wood Products). There are also several instances where the PROD variable is negative and significant (Petroleum & Coal Products, Machinery & Equipment and Electronic Equipment). It is unclear why this is the case, but this may relate to heterogeneity within these broad sectors or PROD is measuring variations in other costs (e.g., taxes) that are included in manufacturing value added.

For the majority of sectors, exports tend to be consolidated in provinces and states that border each other. That is, the parameter estimate for BORDER is almost always positive and, in the vast majority of cases, significant at the 5% level or below. Similarly, trade between states that share a common border (CNTGST) is in all cases stronger than those that do not (see Table 2). The same, however, is not true of provinces. Only in the cases of Stone Clay and Glass and Electronic Equipment is trade between contiguous provinces significantly stronger, at just above the 5% level of significance, than interprovincial trade. The parameter estimates presented in Table 2 also indicate that intraprovincial trade (INPR) tends to be stronger than interprovincial trade and the same is true of intrastate trade (INST) relative to interstate trade. However, the parameter estimates for INST tend to be higher than for INPR, indicating that intrastate trade is relatively stronger than intraprovincial trade, using interstate and interprovincial trade as their respective bases of comparison. The relative strength of contiguous state and intrastate trade may, in part, reflect the double-counting effect noted above. This implies the shipments of auxiliary establishments and wholesalers included in the U.S. database may be biased towards shorter distance flows. The double-counting bias is also reflected in the results for OVEREST, which tends to take on a positive and significant sign. This is an indication that states with a higher ratio of trade to shipments tend to generate more trade. Effectively, these states may be acting as transhipment centres for goods produced in other regions.

The coefficient on MP, with the exceptions of Paper Products and Petroleum and Coal Products, is negative and significant. This confirms the hypothesis that those origins with a higher market potential tend to trade less, *ceteris paribus*, than origins that are less accessible to markets.

Table 2. Trade Model Parameter Estimates

Sector	OUTPUT	DIST	WAGE	PROD	BORDER	CNTGPR	CNTGST	INPR	INST	OVREST	MP	CANUS	PROV	AdjR^2	n[c]
Food Products	**0.9316**	**-1.2509**	**0.9207**	**0.0220**	**0.3775**	**-0.1269**	**0.8079**	**0.2695**	**2.3667**	**0.1519**	**-0.5488**	**-2.1124**	**1.4595**	0.8563	1818
	(0.0000)	(0.0000)	(0.0001)	(0.8676)	(0.0176)	(0.6322)	(0.0000)	(0.4179)	(0.0000)	(0.2201)	(0.0000)	(0.0000)	(0.0000)		
Textiles	**0.9046**	**-0.5157**	**0.2469**	**0.0219**	**0.5590**	**-0.1513**	**0.4995**	**0.8586**	**2.0554**	**0.6616**	**-0.6345**	**-1.5766**	**1.2210**	0.8225	772
	(0.0000)	(0.0000)	(0.3752)	(0.9278)	(0.0232)	(0.6308)	(0.0001)	(0.0243)	(0.0000)	(0.0000)	(0.0032)	(0.0000)	(0.0000)		
Apparel	**0.9071**	**-0.7313**	**-0.6741**	**0.8258**	**0.9283**	**-0.2453**	**0.7219**	**0.1212**	**1.8225**	**1.6169**	**-0.5323**	**-1.2547**	**2.4261**	0.8083	1363
	(0.0000)	(0.0000)	(0.0063)	(0.0000)	(0.0000)	(0.4951)	(0.0000)	(0.7903)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)		
Lumber & Wood Products	**0.7960**	**-0.9756**	**1.0511**	**-0.2037**	**0.7431**	**0.3483**	**1.1025**	**1.1676**	**2.8195**	**0.0457**	**-0.7169**	**-0.5030**	**1.5168**	0.7772	1536
	(0.0000)	(0.0000)	(0.0001)	(0.3175)	(0.0000)	(0.2297)	(0.0000)	(0.0012)	(0.0000)	(0.7711)	(0.0000)	(0.0000)	(0.0000)		
Furniture & Fixtures	**1.0302**	**-0.9580**	**0.1482**	**-0.2348**	**0.2585**	**-0.0232**	**0.3386**	**0.6185**	**1.7623**	**0.3096**	**-0.7325**	**-0.8158**	**1.4843**	0.8380	1222
	(0.0000)	(0.0000)	(0.5332)	(0.1756)	(0.1254)	(0.9292)	(0.0000)	(0.0439)	(0.0000)	(0.0002)	(0.0000)	(0.0000)	(0.0000)		
Paper Products	**0.8596**	**-1.1431**	**0.5031**	**0.4410**	**0.2585**	**0.0353**	**0.4230**	**0.2134**	**1.5451**	**1.7636**	**-0.0741**	**-0.2043**	**2.5601**	0.8260	1529
	(0.0000)	(0.0000)	(0.0445)	(0.0006)	(0.1142)	(0.8967)	(0.0000)	(0.5206)	(0.0000)	(0.0002)	(0.1618)	(0.0632)	(0.0000)		
Chemicals[a]	**0.8533**	**-1.1446**	**1.2997**	**-0.3985**	**0.5113**	**-0.0930**	**0.6193**	**0.0129**	**1.8079**	**2.1747**	**-0.4259**	**-0.7146**	**1.7692**	0.8281	1765
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0069)	(0.7606)	(0.0000)	(0.9730)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)		
Petroleum & Coal Products	**0.4865**	**-1.2292**	**2.1984**	**-1.1886**	**0.8537**	**0.4903**	**1.7753**	**1.6704**	**3.9717**	**-0.5436**	**-0.1551**	**-0.8984**	**0.8891**	0.8461	1598
	(0.0001)	(0.0000)	(0.0395)	(0.0000)	(0.0210)	(0.3876)	(0.0000)	(0.0169)	(0.0000)	(0.6054)	(0.3621)	(0.0015)	(0.1043)		
Rubber & Misc. Plastics	**0.9419**	**-0.9741**	**0.2402**	**0.5274**	**0.3420**	**-0.0316**	**0.4565**	**0.2716**	**1.6772**	**3.5537**	**-0.4208**	**-0.7179**	**2.0175**	0.7273	386
	(0.0000)	(0.0000)	(0.2107)	(0.0000)	(0.0272)	(0.9068)	(0.0000)	(0.4184)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)		
Leather Products	**0.9611**	**-0.5814**	**1.7594**	**0.0082**	**0.0257**	**-0.3722**	**0.4356**	**0.0373**	**1.3853**	**4.0007**	**-1.7696**	**-1.0480**	**2.1458**	0.7078	320
	(0.0000)	(0.0000)	(0.0000)	(0.9830)	(0.9418)	(0.6666)	(0.0779)	(0.9633)	(0.0003)	(0.0000)	(0.0000)	(0.0027)	(0.0059)		
Stone, Clay & Glass	**0.9443**	**-1.0535**	**-0.5539**	**0.0096**	**0.6530**	**0.5682**	**0.6549**	**2.1706**	**2.5836**	**3.6861**	**0.0497**	**-0.8409**	**1.0875**	0.8169	128
	(0.0000)	(0.0000)	(0.0506)	(0.9606)	(0.0001)	(0.0511)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.4373)	(0.0000)	(0.0000)		
Primary Metals	**0.9495**	**-1.1653**	**-0.4478**	**-0.2765**	**0.3043**	**-0.1221**	**0.3586**	**0.5721**	**1.4009**	**1.8488**	**-0.4073**	**-0.7193**	**1.3031**	0.8198	149
	(0.0000)	(0.0000)	(0.0640)	(0.0231)	(0.1239)	(0.7153)	(0.0001)	(0.1798)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)		
Fabricated Metals[b]	**0.9353**	**-1.0393**	**-0.4270**	**-0.1899**	**0.3920**	**-0.0941**	**0.5136**	**0.7119**	**1.8165**	**3.2019**	**-0.1633**	**-1.6612**	**1.2011**	0.8649	189
	(0.0000)	(0.0000)	(0.0126)	(0.1184)	(0.0085)	(0.7100)	(0.0000)	(0.0234)	(0.0000)	(0.0000)	(0.0004)	(0.0000)	(0.0000)		
Machinery & Equipment	**0.9697**	**-0.8157**	**0.3891**	**-0.4068**	**0.9641**	**0.2592**	**0.5976**	**1.0370**	**2.1976**	**2.5427**	**-0.2671**	**-0.5403**	**0.3293**	0.8454	203
	(0.0000)	(0.0000)	(0.0116)	(0.0001)	(0.0000)	(0.3430)	(0.0000)	(0.0023)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0791)		
Electronic Equipment	**1.0167**	**-0.7038**	**0.0664**	**-0.3841**	**0.6432**	**-0.5834**	**0.5087**	**-0.0028**	**2.0198**	**3.8973**	**-0.7163**	**-1.1848**	**1.7778**	0.8579	183
	(0.0000)	(0.0000)	(0.6826)	(0.0000)	(0.0001)	(0.0267)	(0.0000)	(0.9933)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)		
Transport Equipment	**0.9674**	**-0.9994**	**0.3996**	**0.0582**	**-0.3236**	**0.3948**	**0.3604**	**1.5859**	**-0.1223**	**4.3280**	**-1.1278**	**0.2370**	**1.8952**	0.8232	138
	(0.0000)	(0.0000)	(0.0016)	(0.5612)	(0.3407)	(0.0003)	(0.3968)	(0.0000)	(0.1430)	(0.0000)	(0.0000)	(0.0000)	(0.2285)		

Note: p-values are in brackets

[a]Excludes Saskatchewan whose output is underestimated because potash production is classified as mining in Canada and chemicals in the US.

[b]Excludes Colorado, which was identified as an outlier.

[c]All zero flows were excluded from the analysis. Also, flows under one million dollars were rejected in order to ensure consistency across the trade databases used in the analysis, because the U.S. Commodity Flow Survey (Census Bureau, 1997) did not report flows less that a million dollars, while the other databases reported all flows regardless of size.

Border Effect

Turning to the border's influence on trade, it is apparent from the results presented in Table 2, that the border's dampening affect on trade varies considerably across sectors. Its influence is strongest for Food Products, Textiles, Apparel, Leather Products and Fabricated Metal Products. With the possible exception of Fabricated Metal Products, significant tariff and non-tariff barriers to trade remained in 1993 for these sectors. In sectors where Canada has a relatively larger factor based comparative advantage (Lumber & Wood Products and Paper Products) or trade barriers have been eliminated for a considerable period of time (Transportation Equipment), the border effect is smaller, and in the case of Transportation Equipment not significantly different than zero. [10] These results suggest the border does not act as a systematic barrier to trade across all sectors and that its influence on trade is related, at least in part, to trade policies implemented by governments on both sides of the border.

Also included in Table 2 is the interprovincial trade dummy variable, PROV. As expected, it is positive and highly significant across all sectors. Therefore, after controlling for variation in output, distance, wages, productivity and other spatial factors that affect flows (e.g., market potential), interprovincial trade is stronger than interstate trade. This confirms *Hypothesis 1* that if the border is acting as a barrier to trade Canadian provinces should trade more with each other than U.S. states.

In order to provide a perspective on the magnitude of the difference between cross-border trade and interprovincial trade and interstate trade, Table 3 presents estimates of the relative sizes of these flows. The first column includes estimates of the level of cross-border trade relative to interstate trade across the sixteen manufacturing sectors included in the analysis. In the majority of sectors, cross-border trade is less than half of interstate trade. The unweighted average of the relative level of cross-border trade across sectors is 0.45. In other words, cross-border trade is about half the level of interstate trade, or taking the opposite perspective, interstate trade is approximately twice as strong as cross-border trade. This result contrasts sharply with previous estimates of the border effect for 1993. Using interprovincial trade as a benchmark, Helliwell (1998) estimated interprovincial trade was some 13 times greater than cross-border trade. Therefore, the estimated border effect is much less when interstate trade is used as a benchmark, which is consistent with Brown and Anderson (2002) and Anderson and van Wincoop's (2001) results.

By dividing the average level of cross-border trade into the average level of interprovincial trade, it is possible to observe the relationship between interprovincial and cross-border trade. Based in this calculation, interprovincial trade is approximately 12 fold stronger than cross-border trade (see Table 3). This is a ratio that is similar in magnitude to that of Helliwell's (1998) estimate. The lesson to be learned from this is that measurement of the border effect depends crucially upon the benchmark against which cross-border flows are measured.

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[10]Canadian exports of cars and light trucks were allocated by state based on the level of state retail sales in these products. This was done to account for the considerable consolidation of shipment in a few states (e.g., Michigan and New York). Given that the market for these goods is arguably continental in scope, this procedure should add little bias to the results.

Hypothesis 2 stated that the strength of interprovincial trade should fall across sectors as the border effect becomes less prevalent. Therefore, there should be a positive relationship between the border effect and the relative strength of interprovincial trade; that is, the stronger the influence of the border on trade, the stronger interprovincial trade will be relative to interstate trade. The results presented in Table 3 show that there is no apparent negative relationship between the two variables. For example, PROV is positive and significant for Transportation Equipment even though the border effect is insignificant. The same is true of Lumber and Wood Products and Paper Products, which have among the lowest, in absolute value, CANUS parameter estimates.

These results seem to suggest a paradox. As Canadian firms turn to nearby markets in the U.S., our expectation is that they would not maintain their trade links with far-flung Canadian markets. For example, we would expect a producer from Ontario to become uncompetitive in the B.C. market as similar producers in Washington State are able to serve the B.C. market at a lower cost because of its advantageous location.

Why the strength of interprovincial trade appears to be unrelated to the degree of integration of Canadian regions into the U.S. market is unclear. It may be that errors in the data resulting from differences in the trade databases and/or the classifications of industries employed in Canada and the U.S. have sufficiently blurred the results so that we do not observe a relationship between the strength of interprovincial and cross-border trade. Considerable effort has been taken to minimise these errors, but they still may persist. Putting the possibility of errors in the data aside, the next section explores several others factors that might explain this paradox.

Table 3. The Strength of Cross-Border and Interprovincial Trade Relative to Interstate Trade

Sector	Cross-Border (exp(CANUS))	Interpovincial (exp(PROV))
Food Products	0.12	4.30
Textiles	0.21	3.39
Apparel	0.29	11.31
Lumber & Wood Products	0.60	4.56
Furniture & Fixtures	0.44	4.41
Paper Products	0.82	12.94
Chemicals	0.49	5.87
Rubber & Misc. Plastics	0.49	7.52
Petroleum & Coal Products	0.41	2.43
Leather Products	0.35	8.55
Stone, Clay & Glass	0.43	2.97
Primary Metals	0.49	3.68
Fabricated Metals	0.19	3.32
Machinery & Equipment	0.58	1.39
Electronic Equipment	0.31	5.92
Transport Equipment	1.06	6.65
Unweighted Average	*0.45*	*5.58*

A Test of the Influence of Spatial Structure on Trade

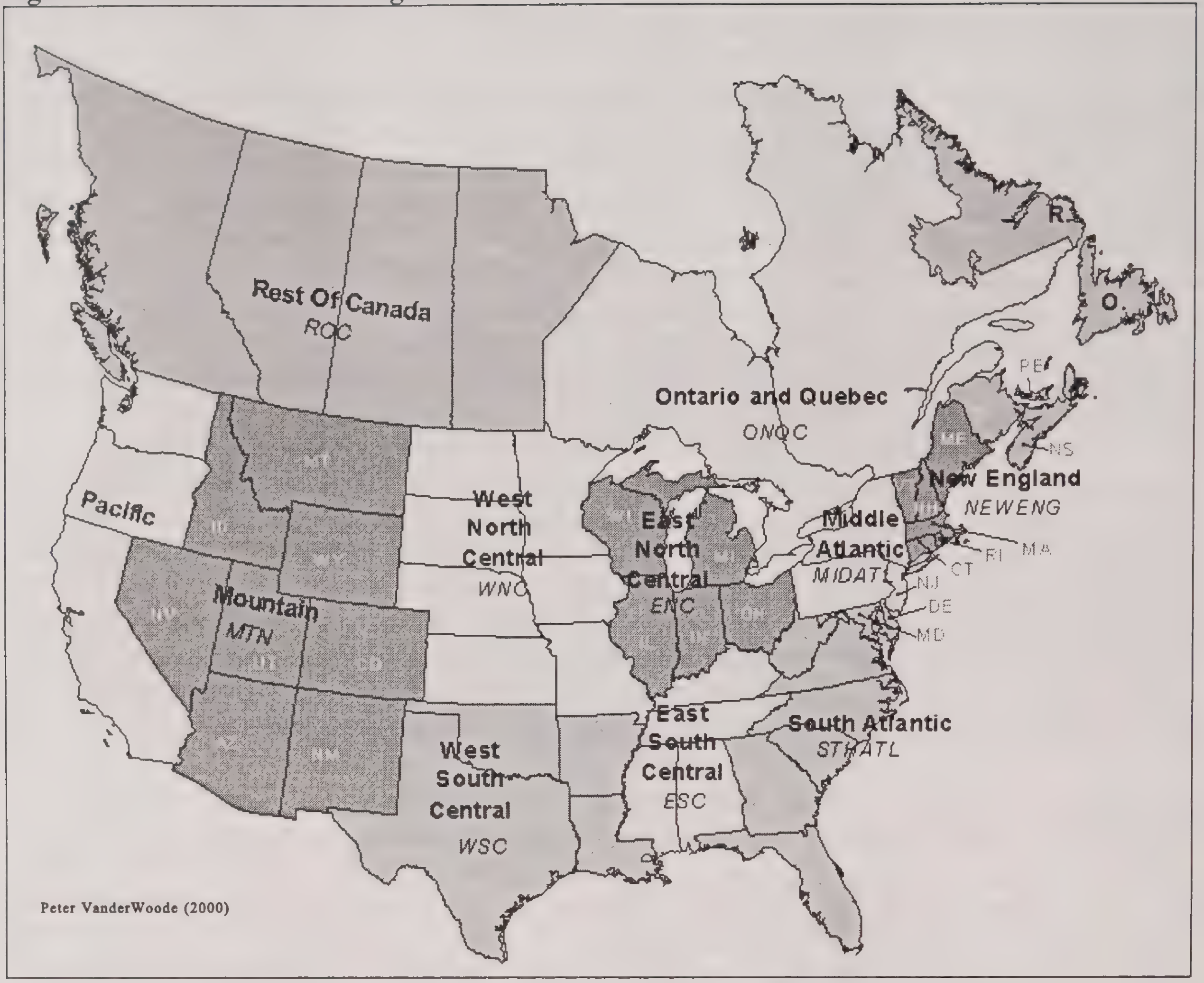
One possible explanation for the fact that *Hypothesis* 2 is not confirmed by the data is that the gravity trade model defined above does not adequately take into account spatial structure, the spatial configuration of supply and demand. In other words, Canadian provinces may be trading more with each other simply because they are sparsely populated and remote from each other and the North American market in general. Of course, considerable efforts have been made to account for how the location of all potential sources of supply influences the decision to purchase goods from a particular region and how the location of producers relative to potential markets, through the MP measure, influences the strength of their trade flows. Nevertheless, it is important to test whether the model adequately takes into account how the location of regional supply and demand influences trade flows.

An admittedly crude approach is to divide the North American continent into a set of regions with a dummy variable assuming a value of one for those flows taking place between states or provinces within each region (see Figure 1). Given that there is considerable variation in the density of economic activity across the continent, this procedure should provide some understanding of the influence of spatial structure on the strength of intra-regional trade that is not accounted for by the model. The null hypothesis is that the model properly accounts for spatial structure, and therefore, there should be no significant difference between the strength of trade between sparsely populated, remote regions and those that have higher densities.

The choice of U.S. regions is based on the Census Bureau's nine census divisions (see Figure 1). These regions contain relatively similar states, and therefore, this is a useful method of grouping states into regions. Canada is divided into Ontario-Quebec (ONQC) and the rest of Canada (ROC). Although ROC is not a spatially contiguous region, it does contain provinces that are remote relative to their primary Canadian and U.S. markets. Tests of the data when Atlantic Canada was excluded showed that there was very little difference in the results. The basis of comparison for all flows is U.S. interregional trade; that is, trade between states that are not part of the same region. OQROC (see Table 4) accounts for Canadian interregional trade and is roughly comparable to the U.S. interregional trade.

The estimated dummy variable coefficients for intraregional trade in Canada and the United States are presented in Table 4, as well as market potential (MP). In most cases, the parameter estimates for MP are negative and significant, which is the expected result. There is no significant difference between intraregional and interregional trade for the majority of U.S. regions and sectors. However, for two of the most sparsely populated and remote regions of the United States, WNC and MTN, intraregional trade is stronger than U.S. interregional trade. Therefore, it would appear that the model does not completely account for spatial structure, even when MP is included.

Figure 1. North American Regions



What does this imply about the relative strength of interprovincial trade? In the majority of cases, the parameter estimates for WNC and MTN are substantially smaller than ROC, which is arguably similar to the WNC and MTN regions. Tests of the restriction that coefficients of ROC=WNC=MTN[11] indicated that in the vast majority of sectors the null hypothesis of their equality could be rejected at a significance level of 0.05 or below. The exceptions were Textiles, Primary Metals and Machinery and Equipment. In these cases, the difference between ROC and inter-regional trade in the U.S. may be due to spatial structures.

[11] For Textiles, Petroleum and Coal Products, and Stone Clay and Glass intra MTN flows were not included, and therefore, the restriction that ROC=WNC was tested. In the case of Leather Products, no restriction was tested because ROC flows were not included.

Ontario-Quebec trade provides an additional perspective on the relative strength of Canadian and U.S. intra-regional trade. Ontario-Quebec flows are significantly higher than U.S. inter-regional trade for the majority of sectors (see Table 4). Moreover, Ontario-Quebec trade is stronger than ENC and MIDATL, which contain states located similarly within the North American market. Using the demand side, this is an indication that consumers and firms in Ontario and Quebec have to trade more extensively with each other than comparable states in the U.S. However, it should also be noted that in several of the cases (see Table 4) there is no significant difference between Ontario-Quebec trade and interstate trade.

Interestingly for Transportation Equipment, Ontario-Quebec trade was no different than trade within similar U.S. regions (e.g., ENC). Given that the border has no significant influence on trade for this sector, this result makes considerable intuitive sense. Nevertheless, the relative strength of ROC and OQROC trade in Transportation Equipment is inconsistent with the hypothesis that the strength of interprovincial trade should assume the same level as interstate trade if the border no longer matters.

Overall, these results indicate that the spatial structure of supply and demand does not significantly influence the model's parameter estimates. The broad conclusion is that the relative strength of interprovincial trade in sectors where the border effect is weak cannot be attributed to the overestimation due to the spatial structure of the Canadian economy. Therefore, it remains that case that *Hypothesis 2* is not confirmed by the analysis.

The fact that *Hypothesis 2* is not confirmed does not mean the logic that underlies *Hypothesis 2* has been rejected. In fact, there is evidence that interprovincial trade has been falling relative to cross-border trade since the late 1980s (Grady and Macmillan, 1998). Rather, these results do suggest that there may be other factors that explain why interprovincial trade remains stronger than interstate trade despite the economic forces acting to draw trade north-south rather than east-west.

There are many reasons why the relationship between interprovincial trade and the border effect is not readily apparent in the data. One possibility is that distance differentially affects Canadian and U.S. trade flows. This may be true if the cost of transporting goods over space is less in Canada because we have built a transportation and distribution system to move goods over long distances. Since a large proportion of the cost of transporting goods is associated with the establishment and maintenance of a distribution system, rather than the direct costs (e.g., fuel and depreciation on equipment) of moving goods over space, this is a plausible hypothesis.

This argument can be taken a step further. At least for differentiated goods, Rauch (1999) has argued that the connections between buyers and sellers are typically not made through organised exchanges but through a search process that relies on pre-existing links between buyers and sellers that results in trading networks. Since the interpersonal networks that facilitate exchange are likely to be stronger within countries, rather than between them (Helliwell, 1998), and in the case of Canada must be spatially extensive, these networks will facilitate long distance trade. Therefore, once national trading systems are in place they are likely to persist because of the capital that has already been sunk into their development and because the long established, and probably robust, interpersonal networks of suppliers and buyers.

Table 4. Comparison of the Intensity of Intra-Regional Trade

Sector	CANUS	ONQC	ROC	OQROC	PACIFIC	MTN	WNC	WSC	ENC	ESC	MIDATL	STHATL	NEWENG	MP
Food Products	**-2.1027**	**1.1629**	**1.2994**	**1.6135**	-0.2203	**0.3432**	**0.2874**	0.0953	-0.3120	0.2599	-0.3140	**0.4471**	0.2837	**-0.5415**
Textiles	**-1.5588**	**1.4655**	**1.7324**	**1.1392**	0.8588	D	**1.1261**	0.2255	0.1387	0.4195	0.0248	0.0254	-0.1300	**-0.4870**
Apparel	**-1.2282**	**2.4524**	**2.1701**	**2.6451**	0.1282	**0.8329**	**0.9029**	0.4559	0.3601	0.1052	-0.1530	0.0745	-0.1113	**-0.4702**
Lumber & Wood Products	**-0.4322**	**1.6570**	**1.4281**	**1.7129**	0.0173	**0.4607**	**0.5213**	**0.8400**	-0.1086	**0.7923**	0.0156	**0.3325**	**0.4258**	**-0.6474**
Furniture & Fixtures	**-0.7778**	**1.5178**	**1.5769**	**1.5638**	0.2780	**0.9163**	**0.6964**	0.3718	-0.2419	0.0017	0.3127	0.2170	0.1506	**-0.6671**
Paper Products	**-0.2928**	**2.5408**	**2.1235**	**2.6541**	**0.5447**	**1.1165**	**0.5038**	0.3506	-0.2733	0.2544	-0.3369	**0.3292**	**-0.3760**	-0.0038
Chemicals	**0.6698**	**1.2133**	**1.5376**	**2.0539**	0.3024	**1.2957**	**0.8115**	-0.0085	-0.1968	0.1923	-0.4492	0.1468	0.0442	**-0.3889**
Petroleum & Coal Products	**-1.1492**	1.8410	0.6006	0.5343	-0.3756	D	-0.7909	-0.8631	-0.3763	0.7422	0.2182	D	D	-0.2305
Rubber & Misc. Plastics	**-0.6833**	**1.8311**	**2.2062**	**2.0347**	0.2907	**0.4301**	**0.5492**	-0.1396	-0.1657	-0.1694	-0.3736	-0.0315	0.3651	**-0.3900**
Leather Products	**-1.1752**	2.0868	D	**1.7561**	-1.1927	D	-0.9540	0.1320	-0.5002		-0.1499	-0.6121	-0.3050	**-1.9309**
Stone, Clay & Glass	**-0.7973**	0.8630	**1.7441**	**1.0552**	0.4265	**0.7089**	**0.6317**	0.2347	-0.1993	0.2974	**0.6930**	0.1477	0.2503	**0.1563**
Primary Metals	**-0.7207**	**1.2870**	**0.8840**	**1.5056**	0.4272	D	**0.4967**	**0.5299**	0.0365	0.0037	**-0.6699**	0.1304	-0.0473	**-0.3975**
Fabricated Metals	**-1.6092**	0.6371	**1.4381**	**1.1778**	0.2755	**0.9204**	**0.6811**	0.2492	-0.1723	0.1487	**-0.5764**	0.0438	**0.3945**	**-0.0988**
Machinery & Equipment	**-0.4561**	-0.2014	**0.7473**	0.3028	0.0376	**0.5839**	**0.7367**	0.2513	**-0.3499**	0.1655	**-0.6095**	-0.0714	**0.4129**	**-0.1676**
Electronic Equipment	**-1.1344**	**1.0124**	**1.9954**	**1.8000**	0.0610	**0.4203**	**0.4855**	-0.0062	-0.0489	0.1005	-0.4840	0.1368	**0.4863**	**-0.6647**
Transport Equipment	0.1157	0.3641	**2.7177**	**1.5758**	0.0960	**0.5625**	0.2987	0.1896	0.0486	0.2531	-0.2085	0.1638	0.4948	-0.0515

Note: Bolded parameters are significant at the 5% level or below. A 'D' is used to indicate those sectors and trading regions where no trade flows were reported, were to small to include in the analysis and/or were suppressed for statistical or confidentiality reasons.

Long-distance trade in Canada may also be stronger than in the U.S. because the less competitive nature of the Canadian market has allowed producers to use uniform pricing policies. That is, firms are able charge the same delivered price for a good regardless of the distance it has to travel from the factory gate to the customer. The obvious consequence of such a pricing policy is that purchasing goods from far away will be no more costly to the buyer than purchasing from a supplier that is more geographically proximate. In other words, Canadians are trading more with each other because they are more insulated from the cost of shipping goods over long distances as a result of more prevalent uniform pricing policies.

Theoretically, it is possible to test for these hypotheses by allowing the distance parameter in Canada to take on a different slope than in the U.S. and observe whether it takes on a positive sign, an indication that distance has less of an effect on flows in Canada. Unfortunately, the nature of the trade databases used in the analysis makes the results of such a test ambiguous. That is, the inclusion of variables to compensate for the differences between the two databases (e.g., CNTGST and CNTGPR) only complicates the interpretation of the differential slope coefficient. Due to this problem, these hypotheses are not tested here and are offered more as suggestions for future research.

7. Conclusion

In this paper, provincial, state and cross-border trade were compared to measure the border effect and the relative levels of interprovincial and interstate trade. The evidence presented suggests that the border effect may be much smaller than once thought and that it is related, at least in part, to tariff and non-tariff barriers to trade. The analysis has also demonstrated that interprovincial trade is stronger that interstate trade. This explains the weaker border effect measured by Brown and Anderson (2002) compared to other studies that relied on interprovincial trade as a benchmark. This result makes considerable intuitive sense. In the presence of significant barrier to trade across the border, firms seeking to take advantage of returns to scale and consumers seeking to satisfy their demand for different varieties of goods, are forced to trade over longer distances than their counterparts in the United States who, on average, have access to a broader range of products and markets in close proximity.

The results also appear to suggest that even without a strong border effect Canadians trade more with each other than do Americans. It is a matter of speculation why this is the case. The relative strength of interprovincial trade may also reflect lower costs of moving goods over space in Canada. It may also be true that Canadian firms, more than those in the U.S., utilise uniform pricing policies that lead to longer distance flows.

Appendix A: Data Sources

In order to estimate a trade model of North American regional trade, several different types of data are required. These include interregional trade flows, sectoral output and demand, measures of distance between regions and other variables that influence the price of goods. The specific characteristics of these variables and their sources are reviewed below.

Dependant Variable - Interregional Trade Flows

The volume of interregional trade was derived from three different databases that measured intra/interprovincial, intra/interstate and cross-border trade for 1993. Each of these databases is described in order below.

Intra and interprovincial trade flows were measured using data derived from the Annual Survey of Manufacturers (ASM). The long-form, which is distributed to large plants, asks respondents to report the destination of their shipments of own manufacturing to each province and for export. In cases where shipments are to head offices, sales offices, wholesalers and/or other distributors, respondents are instructed to report the *first destination* of shipments. The short-form of the questionnaire, which is distributed to small plants, does not include this question (see Statistics Canada, 1995 for examples of the survey forms), and therefore, interprovincial trade generated by small plants are not included in the aggregated flows used the analysis. In total, 93% of all manufacturing shipments in Canada are covered by the long-form sample. Therefore, there is a minor underestimation of internal Canadian trade.

Internal U.S. trade flows are measured using the Bureau of Transportation Statistics' Commodity Flow Survey (CFS) (Bureau of the Census, 1997), which was implemented in 1993.[12] The CFS estimates total intra and interstate merchandise trade in the United States based on a 20% sample of business establishments. Excluded from the survey are commodities transported by pipeline as well as goods covered by SIC 27, Printing and Publishing. The analysis was restricted to flows of manufactured goods (US SICs 20, 22-26, and 28-37) because the provincial trade data are derived from the ASM. SIC 21 (Tobacco Products) was excluded because manufacturing data were largely unavailable for this sector due to data suppression to preserve respondent confidentiality. SIC 38 and 39 were also excluded because of large variations in the Canadian and U.S. definitions of these sectors. For the remaining sectors, the Canadian industrial classifications were directly comparable or could be aggregated to match the U.S. SICs.

An alternative to the ASM based intra/interprovincial trade estimates are those published by the Input-Output Division of Statistics Canada (Statistics Canada, 1998). These data have been used as a measure of interprovincial trade in most of the other studies that attempted to measure the border effect (c.f. McCallum, 1995 and Helliwell, 1998). The Input-Output Division's estimates were not used in this analysis because they report the *final destination* of the goods shipped

[12]These data are reported at the two-digit Standard Transportation Commodity Classification (STCC) level. The STCC is equivalent to the 1956 Standard Industrial Classification (SIC). There are only minor differences between the two-digit SICs in 1956 and the current U.S. 1987 classification, which makes the STCC data comparable to the 1987 SIC.

rather than the *first destination* of the shipment reported by the CFS. If used, the Input-Output Division's estimates might overestimate long distance interprovincial trade flows and underestimate short distance flows compared to the CFS, potentially biasing the estimated relative levels of interstate and interprovincial trade. Since the ASM asked respondents to report the *first destination* of shipments, it is more comparable to the CFS, and it was on this basis that the ASM was chosen.

Trade flows between Canadian provinces and U.S. states in 1993 are derived from Statistics Canada's TIERS (1996) database. Exports are defined by province and state of origin and imports by state of destination and province of clearance. Although there is no guarantee that the reported origin or destination is where a good is manufactured or consumed, the TIERS data do provide a relatively accurate estimate of cross-border trade between provinces and states (see Brown and Anderson, 1999 for a more detailed description of the TIERS data and its limitations). The exception is Canadian exports of cars and light trucks, which appear to be consolidated in and/or allocated to corporate headquarters in New York, Michigan and California before being distributed to the rest of the United States. These flows were reallocated based on each state's share of U.S. retail car and truck sales.

The TIERS data are reported using the Harmonized System (HS) commodity classification at the 6-digit level. All trade flows were converted from the HS classification to the US SIC using a concordance supplied by the U.S. Census Bureau.

Independent Variables

Most of the variables used in the analysis are derived from Statistics Canada's (1995; and special tabulation) and the Census Bureau's (1996) 1993 surveys of both country's respective manufacturing sectors. The Canadian data are reported using Canada's 1980 SIC, which is largely comparable at the two-digit level to the US 1987 SIC. A concordance published by Statistics Canada (1991) was used to adjust the Canadian data where necessary. The Statistics Canada data employ the whole sample of manufactures rather than just plants covered by the long-form, which were used to estimate provincial trade flows. Output is measured as the total value of shipments, rather than shipments of own manufacturer, because the U.S. output is measured as the total value of shipments.

As noted in the text, the model includes a measure of market potential (MP). In order to estimate MP, total state and provincial demand (intermediate and final) for output by industry is required. Total demand is estimated for each state and province using the U.S. 1987 input-output tables (Bureau of Economic Analysis, 1994). The total value of shipments by province in Canada was used to measure total output for each of the manufacturing sectors. For those economic sectors outside of manufacturing, Statistics Canada (1996) was used to estimate gross output for Canada. Gross output for each industry was allocated by province based on its share of the industry's GDP (Statistics Canada, 1995). Data on gross output were only available for 1992, and therefore, levels for 1993 were estimated by inflating gross output by the increase in GDP by industry and province. In addition to industrial output, personal consumption, investment, inventory adjustments and government purchases also had to be estimated. These were obtained from Cansim Matrices 9015-9026. The Canadian output and expenditure data were combined with

similar data by state estimated by the Bureau of Economic Analysis. The U.S. 1987 input-output tables were then used to estimate demand for each of the 2-digit manufacturing sectors output by state and province.

As a note of caution, it should be kept in mind that combining data from two national systems of accounts and using the U.S input-output table for Canada likely results in estimates of demand that are only approximations of their true levels. An alternative procedure would have been to use state and provincial GDP levels. However, this would have masked state and provincial differences in intermediate goods demand, which are better captured by using input-output tables. Therefore, the procedure used here should be viewed as the better of two imperfect alternatives.

The price related variables used in the model are distance, productivity and wages. Distance is used as a proxy for transportation costs and is measured as the straight-line distance between the centroids of each province and state. The centroids are defined as the minimum aggregate travel point (median point) for each province/state. Within province and state distances are measured using the population weighted average distance between census divisions/counties in each province/state. A more complete description of the methodology used to calculate intra and interregional distances can be found in Brown and Anderson (2002). Productivity is measured as value added per employee and wages as pay per employee. Productivity and wage measures are both derived from the Canadian (Statistics Canada, 1995) and U.S. (Census Bureau, 1996) 1993 surveys of manufacturers.

All Canadian data denominated in Canadian dollars were converted to U.S. dollars using the average exchange rate in 1993 of 1.29 CDN/USD (Bureau of the Census, 1995).

Appendix B: Correction for the Overestimation of Provincial Trade

Intra and interprovincial trade flows that are derived from the ASM will tend to overestimate the actual levels of provincial trade. This is because the destination of shipments is often wholesalers and other distributors (including the firms' own warehouses) who may eventually export the manufacturers' goods.[13]

The overestimation of domestic flows can be measured by calculating the difference between exports measured using the ASM and a broader measure of exports published by Statistics Canada for each sector. Table B1, which compares ASM exports to published export figures, illustrates that the ASM does tend to underestimate exports. Taking the difference between ASM and official exports and dividing this figure by the value of internal domestic trade, provides a measure of the degree of overestimation of domestic trade. In eight of the sixteen sectors, domestic trade is overestimated by more than 10% (see Table B1).

Due to this potential bias, it was necessary to adjust provincial trade flows in the eight sectors where the overestimation of domestic trade was substantial. The adjustment was accomplished by using the following simple procedure. The difference between the ASM and actual export levels was subtracted from total domestic trade. This adjusted total domestic trade was divided by its original value, and, in turn, this ratio was multiplied by all provincial trade flows.

This adjustment procedure is based on the assumption that any bias introduced by inclusion of exports in domestic trade is independent of distance. This may not be the case. For example, goods eventually destined for export markets may be shipped over relatively long distances and consolidated in warehouses at the border or in ports before being eventually exported. If true, even the adjusted data may not completely eliminate the bias. That is, the relative strength of interprovincial trade may still be partially related to the erroneous inclusion of exports in this trade. Nevertheless, this procedure should go at least part way to making interprovincial and interstate trade more comparable. It should also be kept in mind that the potential overestimation of domestic trade is too small to explain the relative levels of interprovincial and interstate trade. This procedure addresses the accuracy of the estimates, not their overall validity.

[13]The same is true of the CFS, but given that exports account for only a small proportion of the U.S. GDP this should not result in a significant overestimation of internal trade.

Table B1. Exports Measured by the ASM and a Broader Measure of Trade Reported by Statistics Canada, 1993

	asm	Actual Trade	Difference	Proportion of Domestic Trade
	$ millions			
Food Products	5,094	4,650	-444	-1.20%
Textiles	1,369	1,386	17	0.10%
Apparel	458	1,057	599	13.80%
Lumber & Wood Products	8,824	10,276	1,452	17.40%
Furniture & Fixtures	972	1,341	369	14.70%
Paper Products	12,232	12,250	18	0.20%
Chemicals	5,177	7,149	1,972	12.40%
Petroleum & Coal Products	1,869	3,781	1,912	12.50%
Rubber & Misc. Plastics	2,856	2,919	63	1.20%
Leather Products[a]	145			
Stone, Clay & Glass	965	1,204	239	5.10%
Primary Metals	8,025	11,081	3,056	15.80%
Fabricated Metals	3,257	2,893	-364	-3.70%
Machinery & Equipment	4,198	6,449	2,251	51.40%
Electronic Equipment	9,446	8,992	454	6.20%
Transportation Equipment	47,402	51,506	4,104	30.10%
Total	112,289	126,934	14,790	

[a]Data were unavailabe on trade in Leather Products.

Sources: Statistics Canada (1998 and ASM, special tabulation)

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